

Confirmation no.6481

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	LANKHORST <i>et al.</i>	Examiner:	Lee, E.
Serial No.:	10/539,251	Group Art Unit:	2815
Filed:	June 15, 2005	Docket No.:	NL030259US1
Title:	ELECTRIC DEVICE COMPRISING PHASE CHANGE MATERIAL		

APPEAL BRIEF

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Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Customer No. 65913

Dear Sir:

This Appeal Brief is submitted pursuant to 37 C.F.R. §41.37, in support of the Notice of Appeal filed November 11, 2008 and in response to the rejections of claims 1-11 and 17-22 as set forth in the Final Office Action dated August 15, 2008.

Please charge Deposit Account number 50-0996 (NXPS.443PA) \$540.00 for filing this brief in support of an appeal as set forth in 37 C.F.R. §1.17(c). If necessary, authority is given to charge/credit Deposit Account 50-0996 additional fees/overages in support of this filing.

I. Real Party In Interest

The real party in interest is NXP Semiconductors. The application is presently assigned of record, at reel/frame nos. 021085/0959 to NXP, B.V., headquartered in Eindhoven, the Netherlands.

II. Related Appeals and Interferences

While Appellant is aware of other pending applications owned by the above-identified Assignee, Appellant is unaware of any related appeals, interferences or judicial proceedings that would have a bearing on the Board's decision in the instant appeal.

III. Status of Claims

Claims 1-11 and 17-22 stand rejected and are presented for appeal. Claims 12-16 are cancelled. A complete listing of the claims under appeal is provided in an Appendix to this Brief.

IV. Status of Amendments

No amendments have been filed subsequent to the Final Office Action dated August 15, 2008.

V. Summary of Claimed Subject Matter

Appellant's invention is related to a semiconductor device having a resistor value that is operable in different states based upon a phase change material.

Commensurate with independent claim 1, an example embodiment of the present invention is directed to an electric device with a body having a resistor including a fast growth phase change material (*see, e.g.*, FIG. 1 and paragraph 0055). The phase change material is changeable between a first phase and a second phase via crystallization initiating at an interface between crystalline and amorphous materials (*see, e.g.*, paragraph 0012). The resistor has an electric resistance that depends on whether the phase change material is in the first phase or the second phase, and is configured to conduct a current for enabling a transition from the first phase to the second phase (*see, e.g.*, paragraph 0013).

Commensurate with independent claim 18, another example embodiment is directed to an electric device comprising a crystallization layer, a fast growth phase change material and a resistor (*see, e.g.*, FIG. 1 and paragraph 0055). The fast growth phase change material is on the crystallization layer and changeable from an amorphous phase to a crystallization phase in response to an electrical pulse, by crystallization initiating at an interface with the crystallization layer (*see, e.g.*, paragraph 0012). The resistor includes the fast growth phase change material and has an electric resistance that depends on the phase of the phase change material.

VI. Grounds of Rejection to be Reviewed Upon Appeal

The grounds of rejection to be reviewed on appeal are as follows:

- A. Claims 1-11 and 17-22 stand rejected under 35 U.S.C. §112(2).
- B. Claims 1-7, 9-11 and 17-22 stand rejected under 35 U.S.C. §102(b) over Ovshinsky *et al.* (US Patent No. 5,912,839).
- C. Claim 8 stands rejected under 35 U.S.C. §103(a) over Ovshinsky.

VII. Argument

Appellant understands that the Section 112(2) rejection of claims 18-22 has been withdrawn as indicated in the Advisory Action, and further notes that the Advisory Action appears to have mistakenly indicated that proposed amendments will not be entered, as no amendments were made in the Final Office Action (hereinafter referred to as the “Office Action”).

A. The Rejection Of Claims 1-11 And 17 Under 35 U.S.C. §112(2) Must Be Reversed.

The Section 112(2) rejection is improper because the Office Action’s interpretation of a phase change material as a “singular” material that does not operate under conditions involving “both crystalline and amorphous materials” is contrary to the specification and to well-understood operation of such materials. For example, as described in the Abstract of the specification (and as well known in the art), a phase change material is “changeable between a first phase and a second phase.” Resistors formed with such a material exhibit “an electric resistance which depends on whether the phase change material is in the first phase or the second phase.” As such, the Office Action’s proposed restriction of the phase change material to a singular phase would render the material inoperative for its intended purpose (*i.e.*, a switchable resistive memory element as claimed or otherwise must exhibit the ability to change phase in order to operate under different resistive conditions).

The Section 112(2) rejection is also improper because the Office Action’s assertion that the claimed phase change material cannot include both amorphous and crystalline portions is contrary to the described and well-understood operation of such materials. For instance, both crystalline and amorphous materials are present during a phase change as an interface between crystalline and amorphous materials progresses across the material. This is consistent with the specification’s description of a phase change material, in which “the crystalline phase grows at a high speed, the so-called crystallization speed, from the interface between the amorphous phase and the crystalline phase.” Correspondingly, the phase change material includes both amorphous and crystalline phase materials which form an interface, at least during such a phase change.

The instant use of claim terms is further consistent with multiple issued patents having claims directed to phase change materials. For example, U.S. Patent No. 7,473,921 (issued January 6, 2009) claims “at least a portion of the phase change material is operative to switch between lower and higher electrical resistance states in response to an application of a switching signal to the memory cell, the portion of the phase change material operative to switch between lower and higher electrical resistance states.” Similarly, U.S. Patent No. 7,474,556 (also issued January 6, 2009) claims “a variable resistor containing a phase change material having at least two resistance values based on a current profile passing through the phase-change memory cell.” In both of these recently-issued patents, the claimed phase change material has different properties based upon the state that the material is in (and must do so in order to function properly).

Accordingly, the Examiner’s assertion in the Advisory Action that “a phase change material can only be one of two phases” is not relevant to the claimed characteristic (*i.e.*, a material that is configured to change phase), and contradicts well-known operations of such materials. The Section 112(2) rejection is therefore clearly erroneous and should be reversed.

B. The Rejection Of Claims 1-7, 9-11 And 17-22 Under 35 U.S.C. §102(b) Over The ‘839 Reference Must Be Reversed.

1. The Section 102(b) rejections must be reversed because the Office Actions of record have improperly failed to accord patentable weight to (and ignored) various claim limitations.

The Section 102 rejection must be reversed because the (Final) Office Action has improperly ignored multiple claim limitations, including those in each of the independent claims, and has therefore failed to establish correspondence and/or a *prima facie* case of obviousness. In short and as consistent with the above discussion in connection with issue A, the Office Action’s assumption that the claimed phase change material cannot be configurable for operation in both crystalline and amorphous phases, or cannot include both crystalline and amorphous material, is contrary to Appellant’s specification, well-understood operation of such materials in the art and various issued patent claims. Moreover, the Office Action’s assertions that the phase change properties of the claimed phase change material are “methods used to

make this crystalline structure” are also in direct contrast with relevant law and the M.P.E.P. In short, the Office Action’s failure to accord patentable weight to and address various limitations is accordingly untenable.

As discussed in the record, the Office Action has misconstrued the claimed structure and its configuration as necessitating a single phase state, which is in direct contrast with the operation of the claimed structure. The claimed phase change material exhibits different (stable) amorphous and crystalline states under different operational conditions, with phase changes to the respective states being reversible. Moreover, the claimed phase change material may include materials in both amorphous and crystalline states, such as may occur during a phase change as a line of crystallization moves across the material, or when a phase transition is incomplete. These operational states are exemplified throughout the specification and are consistent with well-known operation of electrically changeable phase change material.

As the Office Action has improperly ignored the claimed characteristics of the phase change material and related body/resistor, the Section 102 rejections must be reversed.

2. The Section 102(b) rejections must be reversed because the rejection is improperly based upon allegedly inherent structures.

The Office Action’s assertion that the cited Te-Ge-Sb alloy “inherently” discloses the claimed invention, simply because the alloy falls into an example range of materials disclosed in the instant application, fails to provide an enabling embodiment that corresponds to all claim limitations. The ‘839 reference does not disclose, discuss or appear to contemplate a phase change material as claimed, involving the cited alloy or otherwise, and fails to show or explain how the cited alloy either would be arranged with other limitations or could operate as claimed. For instance, the Office Action has not asserted that (or described how) the cited Te-Ge-Sb alloy in the ‘839 reference would transition phase as claimed, via crystallization at an interface, as may be relevant to the material’s arrangement in a resistor as claimed and/or operation via conducting current. Moreover, Appellant submits that the cited alloy cannot inherently provide correspondence to the claimed invention, because the ‘839 reference uses materials and approaches that are wholly different from the claimed

invention in nature and operation. The rejections based upon allegedly “inherent” characteristics are thus unsupported, and the Office Action has thus failed to show correspondence, teaching or suggestion of the claimed invention. The Section 102 rejections must therefore be reversed.

3. The section 102(b) rejections must also be reversed because the Office Actions of record have ignored and/or failed to assert correspondence to multiple claim limitations.

In addition to the above, the Office Action has failed to assert correspondence to limitations in various claims, including those directed to growth rate, compositions and materials. Other limitations are ignored as a whole. Specifically regarding the rejection of claim 18 and as applicable to claims 19-22 that depend therefrom, the cited references provide no correspondence to limitations including those directed to a fast growth phase change material that changes phase in response to an electrical pulse, and a resistor that has a resistance dependent upon the phase of the phase change material. Accordingly, the Section 102 rejections of these and other claims to which no correspondence has been asserted must be reversed.

C. The rejection of claim 8 under 35 U.S.C. §103(a) over the ‘839 reference must be reversed.

As discussed above in connection with issues A and B, Appellant believes that the Section 103 rejections are also improper because these rejections rely upon the Section 112 rejections (as indicated at page 2 of the Office Action), in apparently ignoring limitations upon which the Section 112 rejection is based. Moreover, the Section 103 rejection also improperly ignores limitations directed to a phase change material. The Final Office Actions have failed to address these and other traversals (in contrast with the requirements of M.P.E.P. 707.07(f)), and have provided no rationale, from the prior art or otherwise, in support of the assertion that one of skill in the art would somehow have optimized the claimed invention using routine skill where there is no suggestion to do so. Therefore, the Section 103 rejection of claim 8 is improper and should be removed.

VIII. Conclusion

In view of the above, Appellant submits that the rejections of claims 1-11 and 17-22 are improper and therefore requests reversal of the rejections as applied to the appealed claims and allowance of the entire application.

Authority to charge the undersigned's deposit account was provided on the first page of this brief.

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APPENDIX OF CLAIMS INVOLVED IN THE APPEAL
(S/N 10/539,251)

1. An electric device with a body having a resistor comprising a phase change material being changeable between a first phase and a second phase via crystallization initiating at an interface between crystalline and amorphous materials, the resistor having an electric resistance which depends on whether the phase change material is in the first phase or the second phase, the resistor being able to conduct a current for enabling a transition from the first phase to the second phase, the phase change material being a fast growth material.
2. An electric device as claimed in Claim 1, wherein the phase change material has a crystallization speed of at least 1 m/s.
3. An electric device as claimed in Claim 1, wherein the phase change material is a composition of formula $Sb_{1-c}M_c$, with c satisfying $0.05 \leq c \leq 0.61$, and M being one or more elements selected from the group of Ge, In, Ag, Ga, Te, Zn and Sn.
4. An electric device as claimed in Claim 3, wherein c satisfies $0.05 \leq c \leq 0.5$.
5. An electric device as claimed in Claim 4, wherein c satisfies $0.10 \leq c \leq 0.5$.
6. An electric device as claimed in Claim 1, wherein the phase change material is substantially free of Te.
7. An electric device as claimed in Claim 3, wherein the phase change material comprises Ge or Ga in concentrations which range in total between 5 and 35 atomic percent.
8. An electric device as claimed in Claim 3, wherein the phase change material comprises In or Sn in concentrations which range in total between 5 and 30 atomic percent.

9. An electric device as claimed in Claim 1, wherein the phase change material is a composition of formula $\text{Sb}_a\text{Te}_b\text{X}_{100-(a+b)}$, with a, b and $100-(a+b)$ denoting atomic percentages satisfying $1 \leq a/b \leq 8$ and $4 \leq 100-(a+b) \leq 22$, and X being one or more elements selected from the group of Ge, In, Ag, Ga, Zn and Sn.

10. An electric device as claimed in Claim 9, wherein the phase change material comprises at least 10 % and less than 22 % Ge.

11. An electric device as claimed in Claim 9, wherein the resistor has a first contact area and a second contact area, the first contact area being smaller than or equal to the second contact area, the first contact area having a characteristic surface area dimension d (in nm), d being larger than $6 \cdot a/b$.

17. The device of claim 1, wherein the phase change material is responsive to current by changing from an amorphous state to a crystalline state by way of a fast growth crystallization mechanism that is substantially devoid of nucleation.

18. An electric device comprising:

a crystallization layer;

a fast growth phase change material on the crystallization layer and being changeable from an amorphous phase to a crystallization phase in response to an electrical pulse, by crystallization initiating at an interface with the crystallization layer; and

a resistor including the fast growth phase change material and having an electric resistance that depends on the phase of the phase change material.

19. The device of claim 18, wherein the fast growth phase change material changes from an amorphous phase to a crystallization phase in response to a single electrical pulse.

20. The device of claim 18, wherein the fast growth phase change material is responsive to an electrical pulse by crystallizing without nucleation.

21. The device of claim 18, wherein the fast growth phase change material crystallizes at a rate of at least about 1m/s in response to an electrical pulse.

22. The device of claim 18, wherein the fast growth phase change material is responsive to an electrical pulse by crystallizing to change the electrical resistance of the resistor in less than about 20 nanoseconds.

APPENDIX OF EVIDENCE

Appellant is unaware of any evidence submitted in this application pursuant to 37 C.F.R. §§ 1.130, 1.131, and 1.132.

APPENDIX OF RELATED PROCEEDINGS

As stated in Section II above, Appellant is unaware of any related appeals, interferences or judicial proceedings.